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(54) **Sensor system for antilock brakes**

Sensorsystem für Antiblockierbremsanlage

Système capteur pour système de freinage antiblocage

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Description

BACKGROUND OF THE INVENTION

This invention relates generally to sensor systems and, more particularly, to sensor systems for determining the rotation of shafts and axles for vehicles and other applications.

Antilock braking systems and traction control systems are now commonplace in the automotive marketplace and are standard equipment on many car models. The basis of these systems is a sensor system that senses wheel speed or rotation and relays that information to a controller. The controller dictates, for example, the application of braking force intermittently to keep a respective wheel from skidding or slipping. Such use of the braking system allows vehicles to remain in control during maximum braking and to stop more efficiently. Similarly, controllers can dictate the application of driving force for optimum traction.

Current sensor systems for antilock brakes and traction control are of three types: 1) non-integrated variable reluctance type, 2) integrated hub assembly type, and 3) integrated spindle sensor bearing type. Non-integrated variable reluctance sensors often require adjustment after installation. Integrated hub assembly units require a large number of individual parts, introducing problems relating to inventory, installation and service-ability of those parts. Integrated spindle sensor bearings can limit an automotive manufacter to a single supplier and may require new bearing designs to incorporate the sensor and encoder. The Japanese application JP-A-04 244 966 concerns a sensor mounting structure for number of revolution of a wheel for anti-skid control, in which it is impossible to clamp a sensor rotor between a constant velocity joint and a spindle bearing inner race. Moreover, it is impossible to place sealing means to a location proximate to the informations collecting plane.

The foregoing illustrates limitations known to exist in present sensor systems for antilock brakes and the like. Thus, it is apparent that it would be advantageous to provide an alternative directed to overcoming one or more of the limitation set forth above. Accordingly, a suitable alternative is provided including features more fully disclosed hereinafter.

SUMMARY OF THE INVENTION

In one aspect of the invention, this is accomplished by providing a sensor system for antilock brakes and the like comprising an encoded target, target mounting means, probe mounting means, probe means and sealing means such that

- the target mounting means include a target carrier formed of metal conforming to an outer surface (44) of said constant velocity joint for mounting the encoded target for rotation with said wheel spindle ;
- the probe mounting means comprise a ring configured to fit against an inner surface of said steering knuckle ;
- the probe means are adapted to be mounted on said steering knuckle within which the constant velocity joint is mounted, for sensing the encoded target and for generating a signal indicative of rotation of the wheel spindle ; and
- the sealing means are adapted to provide a seal engagement between the target mounting means and the probe mounting means.

The target mounting means is adapted to be clamped between a constant velocity joint and a spindle bearing inner race, such that the encoded target rotates with a wheel spindle over which the spindle bearing inner race is mounted. The probe means is adapted to be mounted on a steering knuckle within which the constant velocity joint is mounted, such that the probe means senses the encoded target and generates a signal indicative of rotation of the wheel spindle.

The invention will be more apparent from the following detailed description when considered with the accompanying drawing figures.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

Fig. 1 is a cross sectional view of an automobile hub assembly having a sensor system for antilock brakes and the like installed therein, illustrating one embodiment of the present invention;

Fig. 2 is a cross sectional view similar to Fig. 1 illustrating a further embodiment of the present invention; and

Fig. 3 is a cross sectional view similar to Fig. 1 illustrating a further embodiment of the present invention.

In this specification, identical elements in different embodiments are given identical reference characters.

DETAILED DESCRIPTION

Referring now to the drawings, Figure 1 illustrates a portion of an automobile hub assembly 10 as might be used, for example, on a front wheel drive automobile equipped with antilock brakes. Hub assembly 10 includes wheel hub 12, wheel spindle 14, constant velocity joint 16, and steering knuckle 18. Steering knuckle 18 is supported by the automobile front suspension, not shown, for pivoting by a steering rack and pinion to effect steerage.

Wheel spindle 14 is an extension of constant velocity joint 16 and is mounted in steering knuckle 18 by spindle bearing 20 for rotation relative to steering knuckle

18. Constant velocity joint 16 provides a universal (pivot) coupling to the automobile transmission and transmits power to wheel spindle 14 to effect rotation of a road wheel mounted on wheel hub 12. Spindle bearing 20 includes outer race 22, inner race 24, and rolling elements 26 between the races, and is provided with a spindle bearing seal 28 to retain lubricant and restrict entry of contaminants.

Hub assembly 10 is equipped with a sensor system which includes a magnet subassembly 30 having a magnet 32, magnet carrier 34, and sensor seal 36. Sensor seal 36 serves as a "slinger" and is molded over magnet carrier 34 and a radially outward portion of magnet 32 to hold magnet 32 in place. Capturing cup 38 is a metal ring having a U-shaped cross section with its cylindrical middle portion mounted within counterbore surface 40 of steering knuckle 18. Capturing cup 38 is dimensioned such that the cylindrical middle portion is engaged by sensor seal 36 to effect sealing of the sensor system.

Capturing cup 38 and magnet subassembly 30 are mounted on steering knuckle 18 before constant velocity joint 16 is installed in steering knuckle 18. Specifically, capturing cup 38 is press-fitted, for example, within counterbore surface 40 and subassembly 30 is held by engagement of sensor seal 36 with capturing cup 38 such that magnet carrier 34 is suspended radially inward. Constant velocity joint 16 is subsequently installed within steering knuckle 18 such that magnet carrier 34 pilots magnet subassembly 30 and a portion of subassembly 30 is clamped between constant velocity joint 16 and spindle bearing inner race 24.

In the embodiment of Figure 1, magnet carrier 34 is formed of metal by pressing, drawing, spinning or other convenient method and is configured with cone portion 42 conforming to an outer surface 44 of constant velocity joint 16. Radially inward edge of cone portion 42 is joined to radial face 46 of magnet carrier 34 that is received within an annular recess 48 in constant velocity joint 16. Magnet carrier 34 has an axially directed lip 50 at its radially outward edge for maintaining radial alignment of magnet 32 and for providing a key surface over which sensor seal 36 is molded.

Although magnet carrier 34 is of a particular annular configuration in Figure 1, other mounting means may be employed with similar effect. For example, magnet carrier 34 may take the form of a bracket with one or more fingers extending radially inwardly to be clamped between constant velocity joint 16 and spindle bearing inner race 24 by abutment with one of those two elements or by other clamping means. In place of cone portion 42, other shapes may be used to guide magnet subassembly 30 into a desired position concentric to constant velocity joint 16 and wheel spindle 14.

Sensor probe 52 is adapted to be mounted on steering knuckle 18 such that a sensor 54 therein is proximate to magnet 32 for sensing a magnetic field produced by magnet 32 and for generating a signal indicative of rotation of wheel spindle 14. Sensor 54 may be a Hall effect sensor or other known magnetic field sensing device. In the embodiment of Figure 1, for example, sensor probe 52 is located by a machined boss 56 and is inserted through an aperture 58 in a portion of steering knuckle 18 overlying constant velocity joint 16 and cone portion 42 of magnet carrier 34.

Collar portion 60 overlies machined boss 56 on steering knuckle 18 to provide a stop surface for locating sensor 54 and to provide a barrier to contamination. Reduced diameter portion 64 extends through a counterbore of aperture 58 and terminates in a beveled end at sensor 54. O-rings 66, provided within an annular groove, are received within the counterbore of aperture 58 to seal out contamination and to provide frictional retention. A bolt (not shown) securing collar portion 60 to steering knuckle 18, or other keying means, may be provided to orient the beveled end and sensor 54 with respect to magnet 32.

Once assembled, the sensor system needs no additional adjustment to ensure proper functioning. Magnet subassembly 30 and sensor probe 52 can be removed to service spindle bearing 20 if necessary. Capturing cup 38 remains pressed in steering knuckle 18 and provides axial location of magnet carrier 34 and, also, a controlled surface for extending the life of sensor seal 36. Sensor probe 52 is highly serviceable since the probe can be removed simply by removing any securing bolt and pulling sensor probe 52 radially outwardly relative to constant velocity joint 16, in the axial direction of aperture 58.

Figure 2 illustrates a further embodiment of the present invention installed within automobile hub assembly 160. This sensor system is similar to that of Figure 1 with magnet subassembly 162 comprising magnet 164, magnet carrier 166 within annular recess 168 of constant velocity joint 170, and sensor seal 172 molded over magnet carrier 166. However, sensor seal 172 extends radially inward over cone portion 174 of magnet carrier 166 and extends radially outwardly as two sealing fingers 176. An additional outwardly extending lip 178 provides an interlock with multi-piece capturing cup 180, by entrapping a radially inwardly extending lip of capturing cup 180.

As with the first embodiment, capturing cup 180 and magnet subassembly 162 can be mounted as a single unit on steering knuckle 182 before installation of constant velocity joint 170 such that radially directed portion 184 is clamped between constant velocity joint 170 and inner race 24 in annular recess 186 of constant velocity joint 170. Sensor probe 186 is mounted on machined boss 188 of steering knuckle 184 by a bolt through hole 190 and may be sealed by O-rings 192. Again, sensor probe 186 is easily removable for service by simply removing the bolt from hole 190 and withdrawing the probe radially outwardly with respect to constant velocity joint 170.

Figure 3 illustrates a further embodiment of the

present invention installed within automobile hub assembly 200. Magnet subassembly 202 comprises magnet 204, magnet carrier 206, and sensor seal 208 with sealing fingers 210 similar to those of Figure 5. Sensor seal 208 interlocks with a radially inwardly extending lip of capturing cup 212. Unlike other embodiments, sensor probe 214 is mounted within a sensor mount 216 that is welded or otherwise fixed to capturing cup 212. Another difference is that sensor 218 of sensor probe 214 is radially aligned with respect to magnet 204 rather than axially aligned, as in the configurations of the other embodiments.

These embodiments include a feature that may be considered a "one-piece" design. Specifically, the probe, magnet subassembly, and capturing cup may be handled as a unit and installed on the respective steering knuckle together. This simplifies assembly by reducing the number of separate parts and steps required. For example, in the embodiment of Figure 3, sensor probe 214 can be inserted in sensor mount 216 of capturing cup 212 before capturing cup is press-fitted or otherwise mounted on steering knuckle 220. Note that this "one-piece" feature is in addition to the ability to remove sensor probe 214 from the sensor system for service.

The magnets of these embodiments may be formed of a resilient rubber-like material with a magnetic filler and molded as a ring. A magnet of that type may be bonded to the magnet carrier. A suitable sensor probe for such magnet could be a Hall effect sensor. In addition, the present invention may employ other encoded targets and probe means. For example, a variable reluctance sensor may be used with an encoded target comprising a toothed wheel or cther form having alternating metal and non-metal portions. A magnetoresistive probe may also be used. However, some of these sensor probes may require more adjustment after installation than others.

The present invention provides a sensor system for antilock brakes which solves the problems relating to adjustment, inventory, serviceability, sourcing and design requirements of prior designs. The sensor system disclosed herein is a stand alone sensing system for antilock braking systems and the like that minimizes the amount of modifications necessary to existing bearings and wheel spindles, is easily serviceable, and requires no adjustment after installation. Each of the illustrated embodiments uses an axially or radially oriented magnet, assembled to a formed piece of metal to provide a bracket that is fixed with respect to the rotatable wheel spindle.

Although the invention has been particularly shown and described with reference to preferred embodiments, it will be understood by those skilled in the art that the foregoing and other changes in form and details may be made therein without departing from the scope of the invention, as defined by the claims appended hereto.

Claims

1. A sensor system for use with antilock brakes, constant velocity joint, wheel spindle and steering knuckle, wherein it comprises :

   - an encoded target (32),
   - target mounting means including a target carrier (34) said target mounting means being formed of metal and conforming to an outer surface (44) of said constant velocity joint (16) for mounting the encoded target (32) for rotation with said wheel spindle (14) ;
   - probe mounting means (38) comprising a ring configured to fit against an inner surface of said steering knuckle (18);
   - probe means (52) adapted to be mounted on said steering knuckle (18) within which the constant velocity joint (16) is mounted, for sensing the encoded target and for generating a signal indicative of rotation of the wheel spindle ; and
   - sealing means (36) adapted to provide a seal engagement between the target mounting means and the probe mounting means.

2. A sensor system according to claim 1, wherein the target mounting means include a target carrier (34) comprising a metal ring to fit against an outer surface at the constant velocity joint adapted to be clamped between the said velocity joint and a spindle bearing inner race (24) mounted on said wheel spindle.

3. A sensor system according to claim 1, wherein the probe mounting means comprise a capturing cup (38).

4. A sensor system according to claim 1, wherein the sealing means comprise a seal (28) fixed to the target carrier (34) such that the seal is engageable with the probe mounting means when the constant velocity joint is installed within the steering knuckle.

5. A sensor system according to claim 1, wherein the sealing means comprise a seal fixed to the probe mounting means such that the seal is engageable with the target carrier (34) when the constant velocity joint (16) is installed with the steering knuckle.

6. A sensor system according to claim 1, wherein the probe means is removable from the steering knuckle (18) for service without removal of the constant velocity joint (16) from the steering knuckle.

7. A sensor system according to claim 1, wherein the encoded target (32) is a magnet and wherein the probe means sense a magnetic field produced by the magnet to generate the signal indicative of ro-

tation.

8. A sensor system according to claim 1, wherein the probe means are a variable reluctance sensor.

9. A method of mounting a sensor system for use with an antilock brake, constant velocity joint, wheel spindle bearing inner race and steering knuckle according to claims 1 to 8, wherein it comprises :

- providing said capturing cup (38) and a subassembly (30), said subassembly including said encoded target (32) and said target carrier (34),
- mounting the capturing cup on said steering knuckle (18), before said constant velocity joint (16) is installed in the steering knuckle, such that the subassembly is captured by the capturing cup,
- installing the constant velocity joint in the steering knuckle such that the target carrier (34) pilots the subassembly and such that a portion of the subassembly is clamped between the constant velocity joint and said spindle bearing inner race (24), and
- mounting said probe means on the steering knuckle such that the probe means sense the encoded target and generate a signal indicative of rotation of a spindle over which the spindle bearing is mounted,
- fitting of the probe mounting means against an inner surface of the steering knuckle,
- provision of sealing means mounted between the target mounting means and the probe mounting means.

10. A method according to claim 9, wherein the probe means are mounted in an aperture of the steering knuckle and extend through the steering knuckle to a location proximate to the encoded target.

Patentansprüche

1. Sensorsystem zur Anwendung mit Antiblockierbremsen, einem Gleichlaufgelenk, einer Radwelle und einem Achsschenkel, umfassend:

- ein codiertes Target (32),

- eine Targetmontagevorrichtung mit einem Targetträger (34), wobei die besagte Targetmontagevorrichtung aus Metall ist und an die Außenfläche (44) des Gleichlaufgelenks (16) angepaßt gestaltet ist, um das codierte Target (32) zum Umlaufen mit der Radwelle (14) montieren zu können;

- eine Fühlermontagevorrichtung (38) umfassend einen Ring, der in eine Innenfläche des Achsschenkels (18) einpaßbar gestaltet ist;

- eine Fühlervorrichtung (52), die an dem Achsschenkel (18) angebracht ist, an welchem das Gleichlaufgelenk (16) montiert ist, um das codierte Target zu erfassen und ein Drehen der Radwelle anzeigendes Signal zu erzeugen, und

- eine Dichtvorrichtung (36) zum Schaffen einer Abdichtung zwischen der Targetmontagevorrichtung und der Fühlermontagevorrichtung.

2. Sensorsystem nach Anspruch 1, bei dem die Targetmontagevorrichtung einen Targetträger (34) mit einem Metallring aufweist, der auf eine Außenfläche des Gleichlaufgelenkes paßt und zwischen dem Gleichlaufgelenk und dem Innenring (24) eines Radwellenlagers eingeklemmt werden kann, der auf der Radwelle sitzt.

3. Sensorsystem nach Anspruch 1, bei dem die Fühlermontagevorrichtung einen Rückhaltenapf (38) aufweist.

4. Sensorsystem nach Anspruch 1, bei dem die Dichtungsvorrichtung eine an dem Targetträger (34) befestigte Dichtung (36) umfaßt, die mit der Fühlermontagevorrichtung in Eingriff steht, wenn das Gleichlaufgelenk in dem Achsschenkel installiert ist.

5. Sensorsystem nach Anspruch 1, bei dem die Dichtungsvorrichtung eine an der Fühlermontagevorrichtung fixierte Dichtung umfaßt, die mit dem Targetträger (34) in Eingriff steht, wenn das Gleichlaufgelenk (16) in dem Achsschenkel installiert ist.

6. Sensorsystem nach Anspruch 1, bei dem die Fühlervorrichtung von dem Achsschenkel (18) zur Wartung entfembar ist, ohne daß das Gleichlaufgelenk (16) vom Achsschenkel dazu entfernt werden muß.

7. Sensorsystem nach Anspruch 1, bei dem das codierte Target (32) ein Magnet ist und die Fühlervorrichtung ein durch den Magnet erzeugtes Magnetfeld erfaßt, um das ein Drehen anzeigende Signal zu erzeugen.

8. Sensorsystem nach Anspruch 1, bei dem die Fühlervorrichtung ein Sensor mit variabler Reluktanz ist.

9. Verfahren zum Anbringen eines Sensorsystems zur Anwendung mit einer Antiblockierbremse, einem Gleichlaufgelenk, einer Innenlaufbahn eines Rad-

wellenlagers und einem Achsschenkel gemäß den Ansprüchen 1 bis 8, umfassend:

- Vorsehen des Rückhaltenapfes (38) und einer Unterbaugruppe (30), welche das codierte Target (32) und den Targetträger (34) umfaßt;
- Montieren des Rückhaltenapfes am Achsschenkel (18), bevor das Gleichlaufgelenk im Achsschenkel installiert ist, so daß die Unterbaugruppe von dem Rückhaltenapf gehalten wird;
- Installieren des Gleichlaufgelenkes im Achsschenkel derart, daß der Targetträger (34) die Unterbaugruppe führt und ein Abschnitt der Unterbaugruppe zwischen dem Gleichlaufgelenk und der Innenlaufbahn (24) des Radwellenlagers eingeklemmt wird, und
- Montieren der Fühlervorrichtung am Achsschenkel, so daß diese das codierte Target erfaßt und ein Drehen der Radwelle, auf welcher das Radwellenlager sitzt, anzeigendes Signal erzeugt,
- Einpassen der Fühlermontagevorrichtung gegen eine Innenfläche des Achsschenkels,
- Vorsehen einer Dichtungsvorrichtung zwischen der Targetmontagevorrichtung und der Fühlermontagevorrichtung.

10. Verfahren nach Anspruch 9, bei dem die Fühlervorrichtung in einer Öffnung des Achsschenkels montiert wird und durch den Achsschenkel hindurch bis zu einem Ort nächst dem codierten Target vorragt.

Revendications

1. Système capteur utilisable avec un système de freinage anti-blocage, un joint homocinétique, un arbre de roue et une fusée de roue, caractérisé en ce qu'il comprend :

- une cible codée (32) ;
- un moyen de montage de cible comprenant un support de cible (34), ledit moyen de montage de cible étant formé d'un métal et épousant la forme d'une surface extérieure (14) dudit joint homocinétique (16) en vue du montage de la cible codée (32) de manière qu'elle tourne avec ledit arbre de roue (14) ;
- un moyen de montage de sonde (38) comprenant un anneau profilé de façon à s'adapter contre une surface intérieure de ladite fusée de roue (18) ;
- un moyen formant sonde (52), adapté pour être monté sur ladite fusée de roue (18) à l'intérieur de laquelle le joint homocinétique (16) est monté, afin de détecter la cible codée et de produire un signal indiquant la rotation de l'arbre de roue, et
- un moyen d'étanchéité (36) adapté pour établir un contact d'étanchéité entre le moyen de montage de cible et le moyen de montage de sonde.

2. Système capteur selon la revendication 1, caractérisé en ce que le moyen de montage de cible comprend un support de cible (34) comportant un anneau métallique et destiné à s'appliquer contre une surface extérieure du joint homocinétique et adapté pour être bloqué entre ledit joint homocinétique et une bague intérieure de roulement montée sur ledit arbre de roue.

3. Système capteur selon la revendication 1, caractérisé en ce que le moyen de montage de sonde comprend une coupelle de retenue (38).

4. Système capteur selon la revendication 1, caractérisé en ce que le moyen d'étanchéité comprend une garniture (36) fixée sur le support de cible (34) de telle sorte que la garniture puisse entrer en contact avec le moyen de montage de sonde quand le joint homocinétique est installé à l'intérieur de la fusée de roue.

5. Système capteur selon la revendication 1, caractérisé en ce que le moyen d'étanchéité comprend une garniture fixée sur le moyen de montage de sonde de telle sorte que la garniture puisse entrer en contact avec le support de cible (34) quand le joint homocinétique (16) est installé dans la fusée de roue.

6. Système capteur selon la revendication 1, caractérisé en ce que le moyen formant sonde peut être enlevé de la fusée de roue (18) en vue d'un entretien, sans avoir à démonter le joint homocinétique (16) de la fusée de roue.

7. Système capteur selon la revendication 1, caractérisé en ce que la cible codée (32) est un aimant et en ce que le moyen formant sonde détecte un champ magnétique produit par l'aimant pour produire un signal indiquant une rotation.

8. Système capteur selon la revendication 1, caractérisé en ce que le moyen formant sonde est un capteur à réluctance variable.

9. Procédé de montage d'un système capteur en vue d'une utilisation avec un système de freinage antiblocage, un joint homocinétique, une bague intérieure de roulement d'arbre de roue et une fusée de

roue, conformément aux revendications 1 à 8, caractérisé en ce qu'il comprend les étapes suivantes :

- disposer d'une coupelle de retenue (38) et d'un sous-ensemble (30) ledit sous-ensemble comportant ladite cible codée (32) et ledit support de cible (34),
- monter la coupelle de retenue sur ladite fusée de roue (18), avant que ledit joint homocinétique (16) soit installé dans la fusée de roue, de telle sorte que le sous-ensemble soit maintenu par la coupelle de retenue,
- installer le joint homocinétique dans la fusée de roue de telle sorte que le support de cible (34) assure le guidage du sous-ensemble et de manière qu'une partie du sous-ensemble soit bloquée entre le joint homocinétique et ladite bague intérieure (24) du roulement d'arbre, et
- monter ledit moyen formant sonde sur la fusée de roue de telle sorte que ce moyen formant sonde détecte la cible codée et produise un signal indiquant une rotation d'un arbre sur lequel le roulement d'arbre est monté,
- disposer le moyen de montage de sonde contre une surface intérieure de la fusée de roue,
- prévoir un moyen d'étanchéité à installer entre le moyen de montage de cible et le moyen de montage de sonde.

10. procédé selon la revendication 9, caractérisé en ce que le moyen formant sonde est monté dans une ouverture de la fusée de roue et s'étend à travers cette fusée de roue jusque dans une position proche de la cible codée.

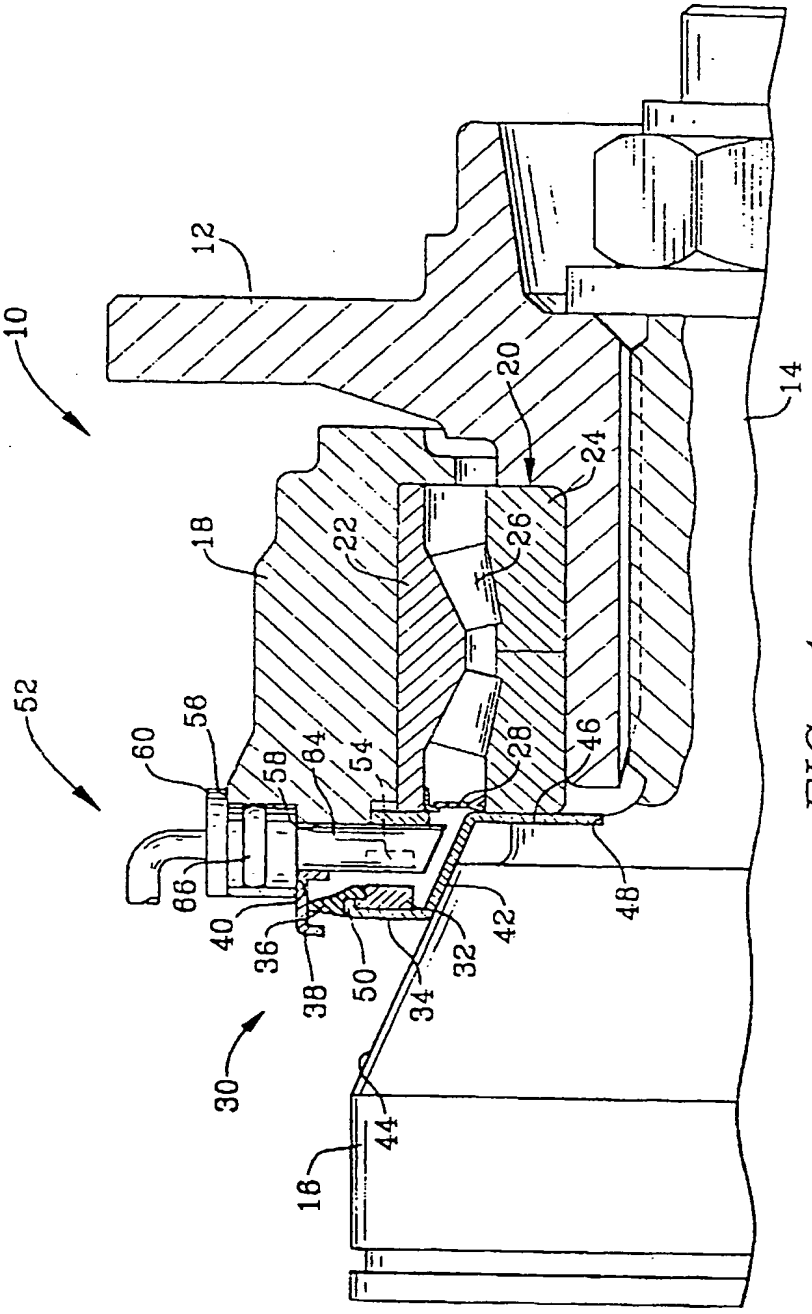
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FIG. 1

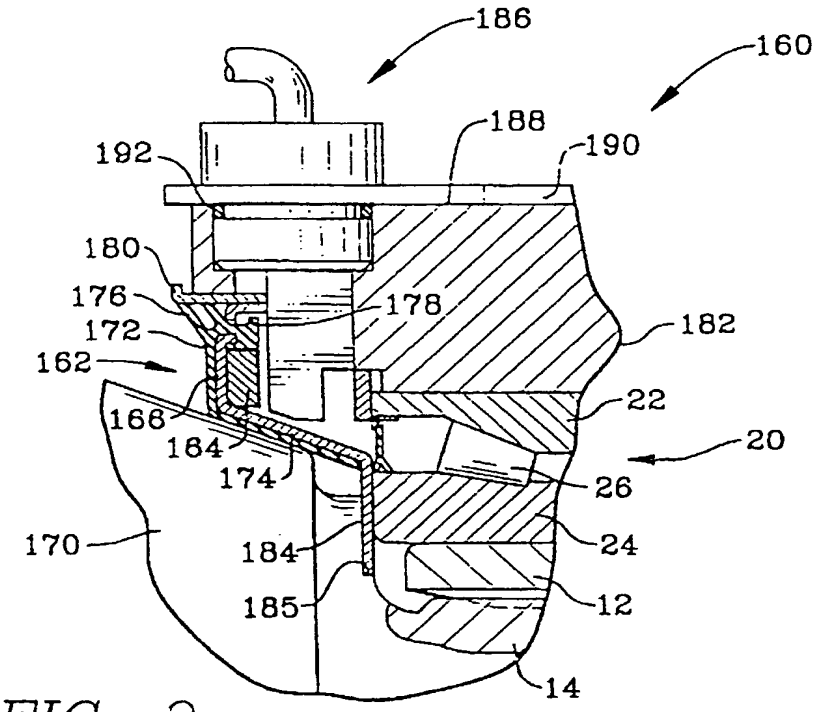
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FIG. 2

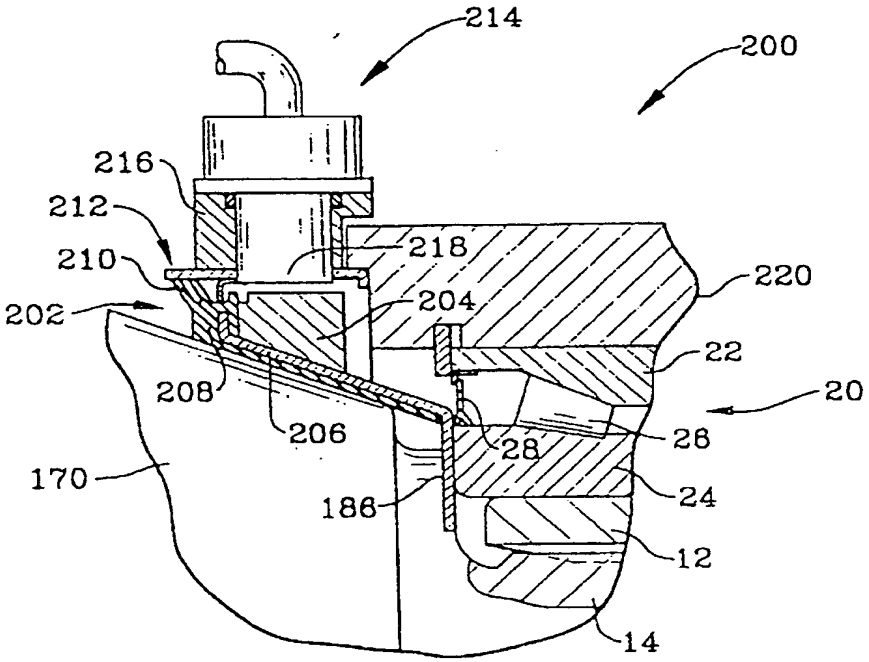
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FIG. 3